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MEMORANDUM REPORT M69-20-1

20

THE DEVELOPMENT OF FIELD EXPEDIENT METHODS FOR FABRICATION OF SILENCERS FOR IMPROVISED WEAPONS

by

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JOHN SCHNIEDER
RICHARD J. SEIBEL

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(6) THE DEVELOPMENT OF FIELD EXPEDIENT METHODS FOR FABRICATION OF SILENCERS FOR IMPROVISED WEAPONS.

by

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RICHARD J. SEIBEL

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ABSTRACT

The objective of this study was to develop practical techniques for the field fabrication of silencers for improvised weapons. Silencers trap propellant gases at the muzzle and release them over an abnormally lengthly time interval thus eliminating a sharp report. Methods of improvising such a system were investigated.

Five component systems were tested for sound, penetration, velocity and fabrication feasibility. Results of these tests are presented.

FOREWORD

The work described in this report was performed by the Frankford Arsenal, U.S. Army Munitions Command under AMCMS Code 5523.11.35402.01, DA Project Number 1W523801A354. Acknowledgement is made to Mr. Robert Cooper, J8100, for providing valuabe experimental data.

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INTRODUCTION

This study was conducted under the Improvised Munitions Program. The purpose of the program was to increase the effectiveness of Special Forces and their trained guerrilla or counterguerrilla troops throughout the world by providing them with instructions on the fabrication of munitions from commonly available items. The findings will be incorporated into the Improvised Munitions Handbook.

DISCUSSION

The approach followed in the field fabrication of silencers assumed the availability of threaded pipe, pipe fittings, cotton, grenade containers, hand drill, drill bits, and cloth. Efforts were devoted to developing simple techniques that would safely and reliably make the signature (noise, flash, and smoke) of these weapons comparable to that of standard small arms weapons with available silencers. Initital work consisted of a literature search on silencer patents and similar material.

The literature search* indicated that all silencers seemed to have common characteristics. In essence, the propellant gases are diverted, at the muzzle of the weapon, through a porous material and/or a series of baffles. This reduces the signature because the gases are released into the atmosphere gradually rather than suddenly.

PROCEDURE

The steps taken to develop field fabrication of silencers for improvised weapons were:

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*Reference AMCP 706-251, "Muzzle Devices," May 1968.

1. Literature Search - Survey patents and literature for methods of reducing weapon signature which may be adaptable to practical field use.

2. Plans for development of improvised types of silencers pursued the following course:

   a. Define most appropriate method.

   b. Perform field experiments and evaluate results by comparing with known systems.

   c. Select optimum silencer for each weapon and verify.

TEST RESULTS

Standard Weapons Study

Improvised low signature systems (.22 caliber, 9mm, .38 caliber and .45 caliber pistols and the 7.62mm rifle) were developed for improvised weapons and silencers. The required materials are commonly available, such as a grenade container, standard pipe and fittings, cotton, and a hand drill and bits. Listed in Table I are the standard weapons used for comparison to improvised weapons.

Diverter Study

The silencers developed consisted of several parts; namely,

1. diverter,
2. container,
3. packing material, and
4. wad.

TABLE I. Standard Weapons Study

Weapon	Velocity fps	Peak Sound with Readings no silencer (db)	10 meters w/silencer	Silencer Type
.45 Caliber pistol	830	124	101	Bell Lab
9mm pistol	1150	140	114	(WWII) Mil
7.62mm rifle	2700	150	Not available	
.38 Caliber pistol	850	125	Not available	

Note: Velocity is measured at muzzle.

A diverter consists of a length of pipe with a series of holes (see Figure 1). Two pipe couplings, a container, and cotton packing were used in conjunction with the diverter (see Table II). Design studies and tests were conducted to find optimum dimensions and other characteristics for each of the systems in order to determine the most suitable diverter. Listed below are those found to be acceptable:

1. .45 Caliber - Design #4

2. 9mm - Design #4

3. 7.62mm - Design #4*

4. .38 Caliber - Design #4*

4. .22 Caliber - Design #3

*Through continuous testing the 9mm Design #4 was found to be a suitable combination for the 7.62mm and the .38 Caliber low signature systems.

A: Normal Pipe Diameter
B: Pipe Length
C: Center Distance
D: Hole Diameter
E: Number of holes per row

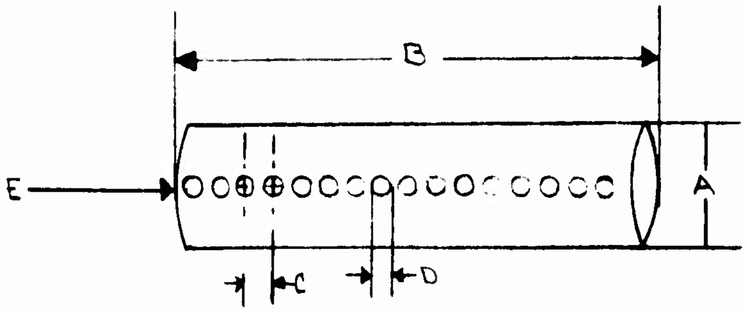


Figure 1. Diverter Dimensions

TABLE II. Diverter Measurements

Weapon	Design No.	A	B	C	D	E	Total Holes (4 rows)
		Dimensions (in.)					
.45 Caliber	1	3/8	24.0	5/8	11/32	15	60
	2	3/8	6.0	1/2	21/64	10	40
	3	3/8	11.0	5/8	1/4	16	64
	4	3/8	6.0	3/8	1/4	12	48
9mm and .38 Caliber	1	1/4	6.0	3/8	1/8	12	48
	2	1/4	6.0	3/8	5/32	12	48
	3	1/4	6.0	3/8	3/16	12	48
	4	1/4	6.0	3/8	1/4	12	48
	5	1/4	6.0	3/8	9/32	12	48

TABLE II. Cont'd

Weapon	Design No.	Dimension (in.) A	B	C	D	E	Total Holes (4 rows)
7.62mm	1	3/8	12.0	1/2	1/4	16	64
	2	3/8	6.0	3/8	1/4	12	48
	3	3/8	6.0	3/8	9/32	12	48
	4	1/4	6.0	3/8	1/4	12	48
	5	1/4	6.0	1/4	3/16	12	48
	6	3/8	6.0	1/2	21/64	10	40
.22 Caliber	1	1/8*	6.0	1/4	3/32	16	64
	2	1/8*	6.0	1/4	1/8	16	64
	3	1/8*	6.0	1/4	5/32	14	56

*Extra heavy pipe

Container Study

In order to fabricate an improvised low signature system, a suitable container had to be selected. The volume of the container affects the noise level up to a point. Diameter as well as the length was considered. The containers found to be most suitable and available were the 60mm mortar or grenade containers. In this study various lengths of pipe and containers were used along with the acceptable diverter to record sound data (see Table III.) Other containers were tested but they did not perform as well. Two-piece containers are desireable because of easy loading of packing material.

Packing Material Study

In order to find the optimum single packing material for improvised use, suitable substitutes such as cotton, fiber glass, steel wool, and hospital gauze were tested for comparison. For this experiment, the .45 caliber and the 9mm low signature systems

TABLE III. Container Measurements

Weapon	Design #4 (pipe length)	Holes per Row	Total Holes	Peak (db) (10 meters)	Average Reading (db)	Muzzle Velocity (fps)	Average Readings (fps)
.45 Caliber	3/8" x 11.0"	26	104	102	98	504	509
				92		518	
				100		505	
.45 Caliber	3/8" x 9.0"	19	76	104	104	507	507-2/3
				105		513	
				103		503	
.45 Caliber	3/8" x 6.0"	13	52	112	109-1/3	504	510
				105		510	
				111		516	
9mm	1/4" x 10.5"	24	96	102	103	807	808
				105		819	
				104		797	
9mm	1/4" x 8.0"	19	76	109	108	835	833
				110		850	
				106		835	
9mm	1/4" x 5/5"	12	48	113	114	929	921
				114		902	
				114		932	
7.62mm*	1/4" x 10.5"	24	96	95	95	774	696
				94		612	
				95		704	
7.62mm	1/4" x 8.0"	19	76	102	104	750	783
				105		886	
				106		713	
7.62mm	1/4" x 5.5"	12	48	105	103	669	667
				103		565	
				102		767	

*Modified Charge (24 gr.)

were applied (see Table IV). Packing material comparison data was taken not using low signature systems. Results of the experiment showed cotton to be the most suitable. Continuous experimenting proved that a rotation of half an inch of the container after each firing added longer life and durability. The target used for this experiment consisted of one-inch thick nominal pine, considered lethal penetration thickness, located 30 meters from the muzzle of the low signature system.

Wad Study

The bullet outside diameter (O. D.) in all systems was undersized in comparison to the pipe inside diameter (I. D.); therefore, a muzzle wad (see Figure 2) was employed to trap the escaped gases which override the bullet while passing through the pipe (barrel) and low signature system. The .22 caliber system is the only exception where a muzzle wad is not applied due to the tight fit of the lead bullet in the extra heavy pipe. The results of the study are listed in Table V. The most acceptable wad size of each caliber was:

1. 1" x 4" wad (9mm)

2. 1.5" x 6" wad (.45 Caliber)

3. 1" x 4" wad (7.62mm)

NOTE: Wad used was absorbent cotton.

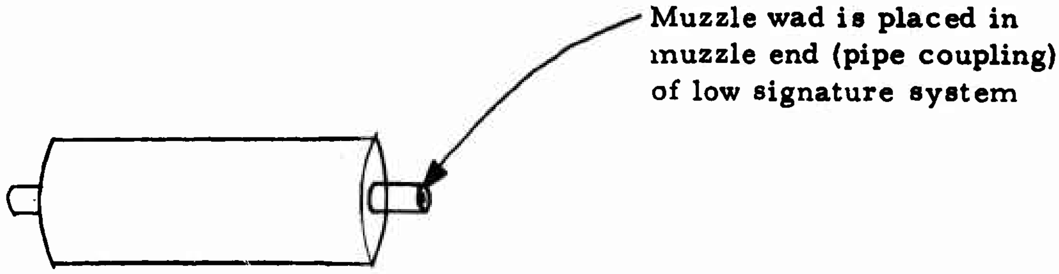


Figure 2. Muzzle Wad Placement

TABLE IV. Packing Material Data (Using Improvised Weapon and Container)

Design	Packing Material	Peak (10 meters)	Average db	Target Penetration (%)
.45 Caliber	Cotton	103 100 105 100	102	100
	Fiber glass	114 110 112 113	112	100
	Steel wool	110 113 110 114	111	100
	Hospital gauze	111 113 112 113	112	100
.45 Caliber Improvised Pistol	No low signature system	128 127 128	128	100
9mm	Cotton	107 106 106 107	106	100
	Fiber glass	112 116 117 117	115	100
	Steel wool	113 116 113 112	112	100
9mm	Hospital gauze	118 117 117 118	117	100
9mm Improvised Pistol	No low signature system	132 134 132	132	100

TABLE V. Wad Study Data

9mm Design #4			.45 Cal Design #4			7.62mm Design #4		
Wad Size	Peak (db)	Avg	Wad Size	Peak (db)	Avg	Wad Size	Peak (db)	Avg
1" x 4"	102	103	2" x 12"	101	103	1" x 4"	95	94
	105			108			94	
	104			102			95	
1" x 6"	109	111	2" x 10"	102	106	1" x 6"	112	102
	112			109			96	
	113			107			100	
1" x 8"	110	110	2" x 8"	102	107	1" x 8"	114	111
	108			111			114	
	113			110			107	
2" x 4"	106	108	2" x 6"	114	112	2" x 4"	102	103
	112			110			101	
	108			114			106	
2" x 6"	108	107	1" x 12"	105	107	2" x 6"	112	108
	105			108			106	
	110			110			108	
2" x 8"	112	110	1.5" x 6"	94	96	2" x 8"	105	105
	111			101			101	
	107			94			110	

Velocity and Penetration Data

Improvised weapons are far from being long range weapons; therefore, the purpose of this experiment was to obtain data for lethality and range (see Table VI). Although there was a slight decrease in velocity when using silencers on improvised weapons, all systems did prove to be effective up to 30 meters. Beyond this point it would be hard to hit a target due to lack of gun sights and rifling. The target used for this experiment consisted of one-inch thick nominal pine, lethal penetration thickness, located 30 meters from the muzzle of the low signature system. Printed circuit paper screens were used to record velocity.

TABLE VI. Velocity and Penetration Data

Diverter	Muzzle Vel (fps)	Penetration (%)	Avg Vel (fps)
.45 Caliber Design #4/ Cotton	456 480 442 445	100	456
No low signature system	480 481 472	100	477
9mm Design #4/ Cotton	837 839 855 848	100	844
9mm; No low signature system	837 827 841	100	834
7.62 mm Design #4/ Cotton Modified Round	860 965 828 896	100	887

TABLE VI. (Cont'd)

Diverter	Muzzle Vel (fps)	Penetration (%)	Avg Vel (fps)
No low signature system	854	100	837
	799		
	816		
	882		
.38 Caliber 9mm Design #4/ Cotton	750	100	721
	708		
	691		
	737		
No low signature system	741	100	749
	766		
	727		
	764		
.22 Caliber (long rifle) Design #3/ Cotton	1062	100	1036
	1032		
	1016		
	1036		
No low signature system	1021	100	1034
	1060		
	1031		
	1024		
.22 Caliber (short) Design #3/ Cotton	890	100	908
	900		
	926		
	914		
No low signature system	932	100	947
	923		
	954		
	980		

Sound Study Data

After experimenting with diverters, containers, packing, and wad tests, suitable complete systems were decided on and then tested for sound level to determine their effectiveness.* Comparable Data, see Table VII, shows the relationship between all calibers with and without a low signature system.

TABLE VII. Sound Study Data

Low Signature System	Peak db at 10 meters (with system)	Avg	Peak db at 10 meters (without system)	Avg
.45 Caliber Design #4/ Cotton	112		128	
	105	109	127	128
	111		128	
9mm Design #4/Cotton	113		132	
	114	114	134	132
	114		132	
7.62mm	105		135	
9mm Design #4/Cotton	103	103	139	136
Modified Charge	102		134	
.38 Caliber	92		112	
9mm Design #4/Cotton	93	92	113	112
	92		112	
.22 Caliber (long rifle)	76		91	
Design #3/Cotton	80	77	90	91
	76		92	

*General Radio Impact Noise Level Meter Recorded All Sound Data

Life Study

Continuous experiment with the .45 caliber, 9mm, 7.62mm and the .38 caliber low signature systems, without repacking the container material and using the rotation system, established a life of 25 rounds. After this, a powder residue formed on the cotton restricting it from absorbing the spent gases. Due to lead buildup from the .22 caliber round (lead bullet), the .22 caliber low signature system was limited to 75 rounds before the velocity dropped. Tests showed that after a maximum number of rounds were fired, projectile failed to penetrate one-inch nominal pine target at 30 meters (max. range). If the improvised barrel was drilled or heated to remove the lead, it could be reused.

Round Modifications and Charge Establishment

Of all the systems studied the 7.62mm NATO round was the only one which required modification. Due to its high velocity and bullet tumble (due to the bullet length and no rifling), it was necessary to slow down its velocity and reduce the bullet length to permit the low signature system to operate properly.

Modification

1. Pull bullet from case
2. Cut bullet, as shown in Figure 3
3. Remove half of the propellant from the case and discard
4. Lightly pack cotton in the case
5. Replace the bullet.*

*A piece of cotton placed around the base of the bullet will make a better sealed bullet when replacing.

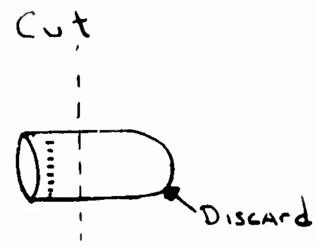


Figure 3. Bullet Modification

After experimenting with various charges (see Table VIII), it appeared that half of the propellant was sufficient to operate the low signature system properly and still be lethal at 30 meters.

TABLE VIII. Charge Establishment

Charge	Velocity (fps)	Average Velocity	10 meters Peak (db)	Average Peak
1/2	860	887	105	107
	965		111	
	828		105	
	896		108	
1/3	925	974	110	109
	954		111	
	1005		110	
	1013		108	
1/4*	646	708	108	109
	777		109	
	718		109	
Standard Round	854	823	139	136
No low signature	799		134	
system	816		135	

*NOTE: 1/4 Charge produced wad stoppage in low signature system muzzle. Velocity measured at muzzle

Smoke and Flash Test

Using a low signature system under concealment, daylight or nightfall made it necessary to obtain smoke and flash data. Photographs and visual data were taken on the smoke test. No smoke appeared visually or on film. According to the pictures the muzzle wad appeared to pulverize when the projectile passed through it. The flash test was shot during total darkness, and viewed through a mirror placed ten feet in front of the muzzle of the low signature systems. The 9mm system was the only system that showed any detection and this consisted of merely a few sparks.

CONCLUSIONS

Five individual low signature systems (see Appendix) of moderate construction can be rapidly manufactured from materials accessible in most parts of the world. All systems have been tested and found lethal up to 30 meters. Inclusion material for the Improvised Handbook was derived from this study.

APPENDIX

Section III
No. 11

LOW SIGNATURE SYSTEM

Low signature systems (silencers) for improvised small arms weapons (Section III) can be made from steel gas or water pipe and fittings.

MATERIAL REQUIRED:

Grenade container
Steel pipe nipple, 6 in. (15 cm) long - See Table I for diameter
2 steel pipe couplings - See Table II for dimensions
Cotton cloth - See Table II for dimensions
Drill
Absorbent cotton

PROCEDURE:

1. Drill hole in grenade container at both ends to fit outside diameter of pipe nipple. (See Table I.)

2. Drill four (4) rows of holes in pipe nipple. Use Table I for diameter and location of holes.

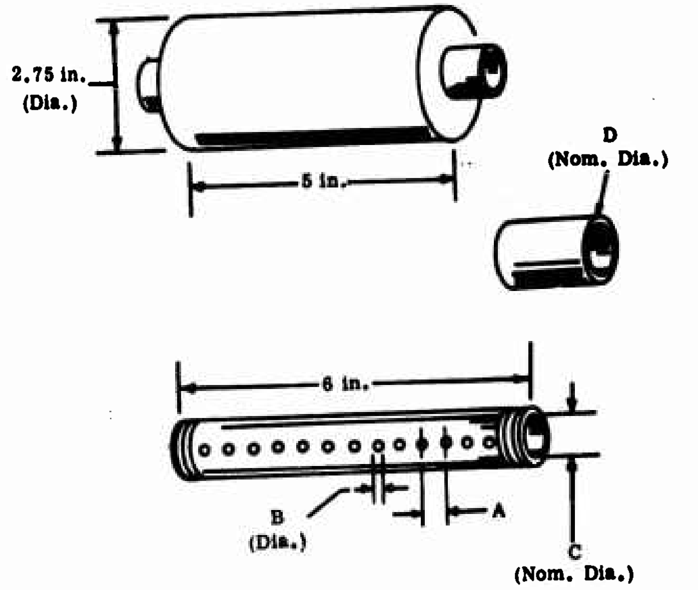
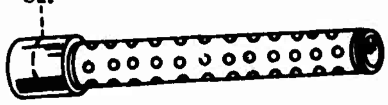


Table I. Low Signature System Dimensions

	A	B	C	(Coupling) D	Holes per Row	(4-Rows) Total
.45 Cal.	3/8	1/4	3/8	3/8	12	48
.38 Cal.	3/8	1/4	1/4	1/4	12	48
9 mm	3/8	1/4	1/4	1/4	12	48
7.62 mm	3/8	1/4	1/4	1/4	12	48
.22 Cal.	1/4	5/32	1/8*	1/8	14	50

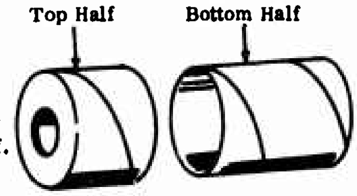
*Extra Heavy Pipe
All dimensions in inches

3. Thread one of the pipe couplings on the drilled pipe nipple.

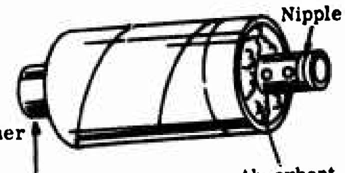


4. Cut coupling length to allow barrel of weapon to thread fully into low signature system. Barrel should butt against end of the drilled pipe nipple.

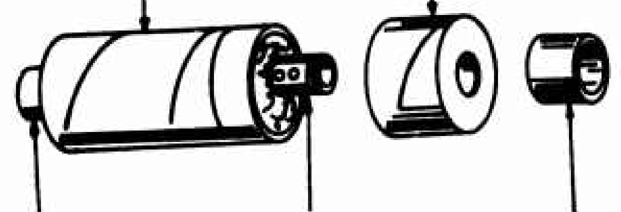
5. Separate the top half of the grenade container from the bottom half.



6. Insert the pipe nipple in the drilled hole at the base of the bottom half of container. Pack the absorbent cotton inside the container and around the pipe nipple.



7. Pack the absorbent cotton in top half of grenade container leaving hole in center. Assemble container to the bottom half.



8. Thread the other coupling onto the pipe nipple.

__NOTE:__ A longer container and pipe nipple, with same "A" and "B" dimensions as those given, will further reduce the signature of the system.

__HOW TO USE:__

1. Thread the low signature system on the selected weapon securely.

2. Place the proper cotton wad size into the muzzle end of the system.

Table II. Cotton Wadding - Sizes

Weapon	Cotton Wad Size
.45 Cal.	1-1/2 x 6 inches
.38 Cal.	1 x 4 inches
9 mm	1 x 4 inches
7.62 mm	1 x 4 inches
.22 Cal.	Not needed

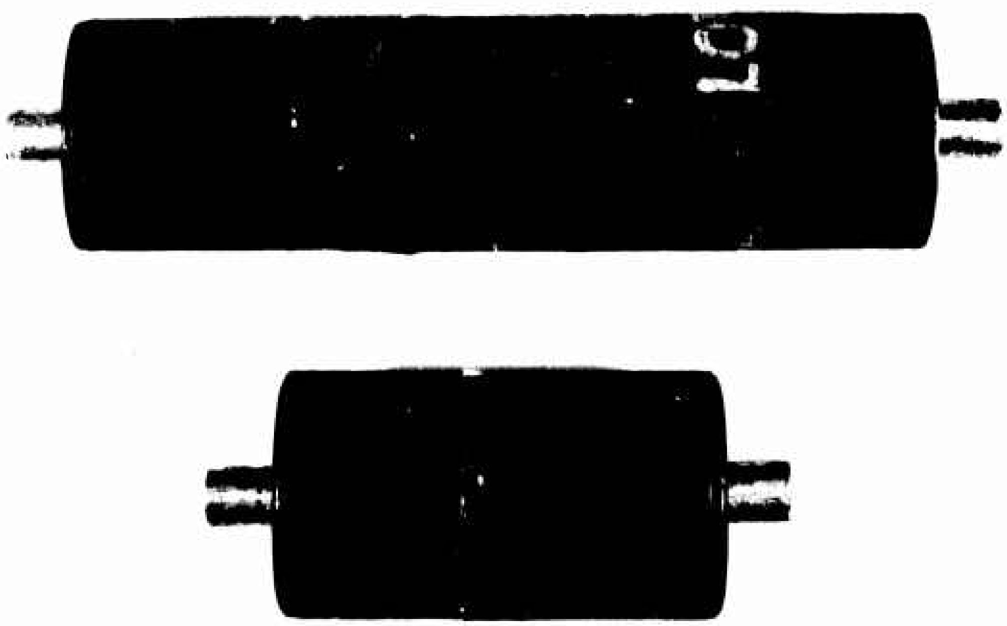
3. Load Weapon

4. Weapon is now ready for use.

Figure A-1. Low Signature System .45 Caliber

LOW SIGNATURE SYSTEM

45 CALIBER



LOW SIGNATURE SYSTEM

9M.M. & 7.62 M.M.

Figure A-2. Assembly of the Low Signature System

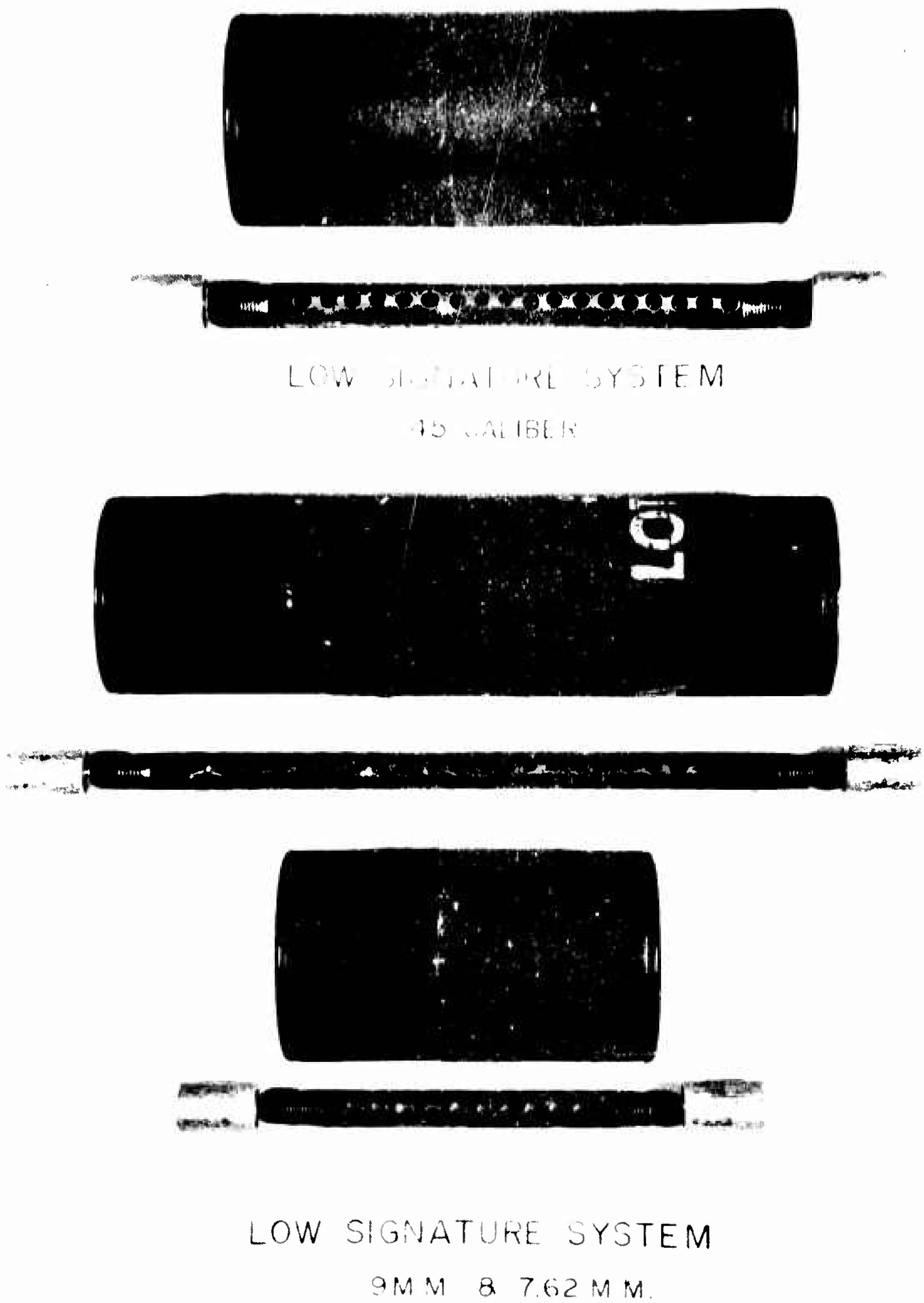


Figure A-3. Parts of the Low Signature System

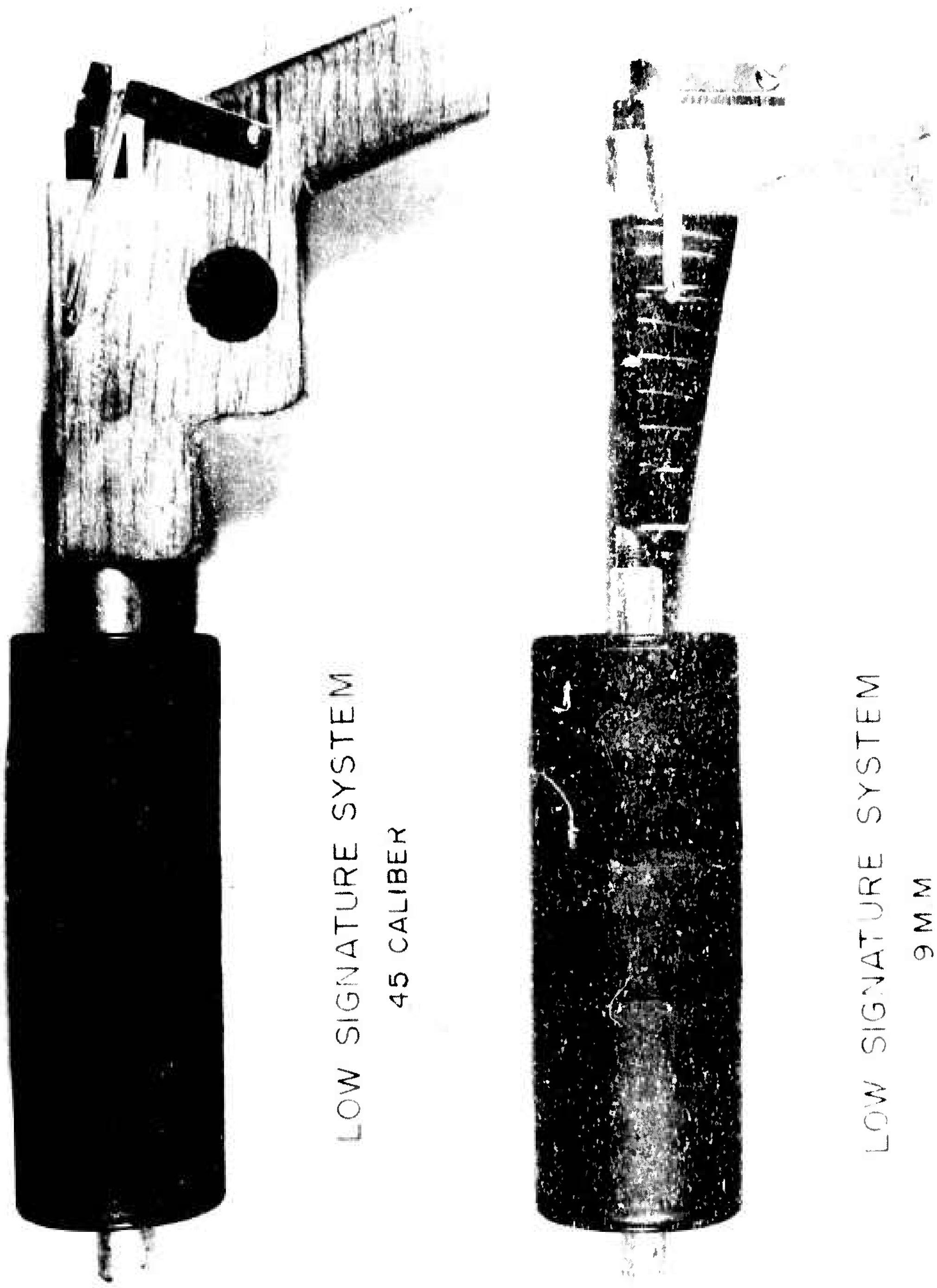


Figure A-4. Assembled Weapon Using the Low Signature System

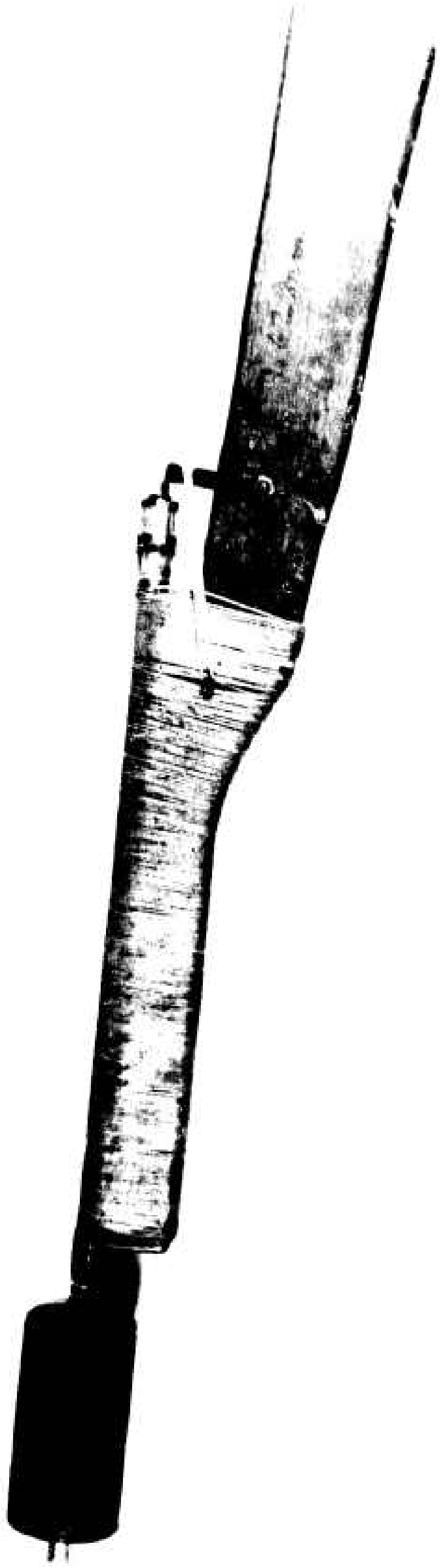


Figure A-5. Low Signature System 7.62mm

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13. ABSTRACT

The objective of this study was to develop practical techniques for the field fabrication of silencers for improvised weapons. Silencers trap propellant gases at the muzzle and release them over an abnormally lengthly time interval thus eliminating a sharp report. Methods of improvising such a system were investigated.

Five component systems were tested for sound, penetration, velocity and fabrication feasibility. Results of these tests are presented.

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